CERES Science Team Meeting
Livermore, CA – October 4-6, 2011

ScaRaB on Megha-Tropiques

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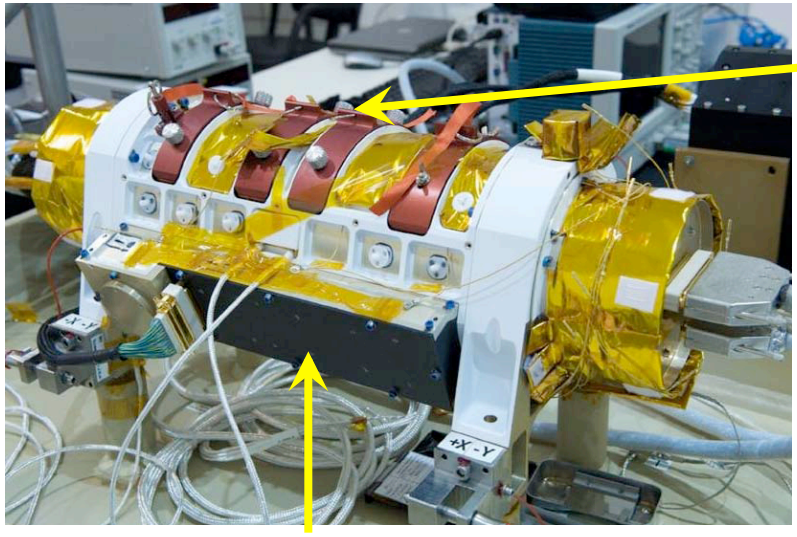
ISRO-CNES
megha-tropiques

Outline

- ScaRaB on Megha-Tropiques
- ScaRaB products
- ScaRaB calibration/validation status

The ScaRaB instrument



Calibration module

22 kg, 52 cm width, 40 watts
4 telescopes (in red)

- **2 main channels (# 2 & 3, broad band)**
- **2 auxiliary channels (# 1 & 4 narrow band)**
- **Cross track scanning (2300 km swath)**
- **40 km resolution at nadir**

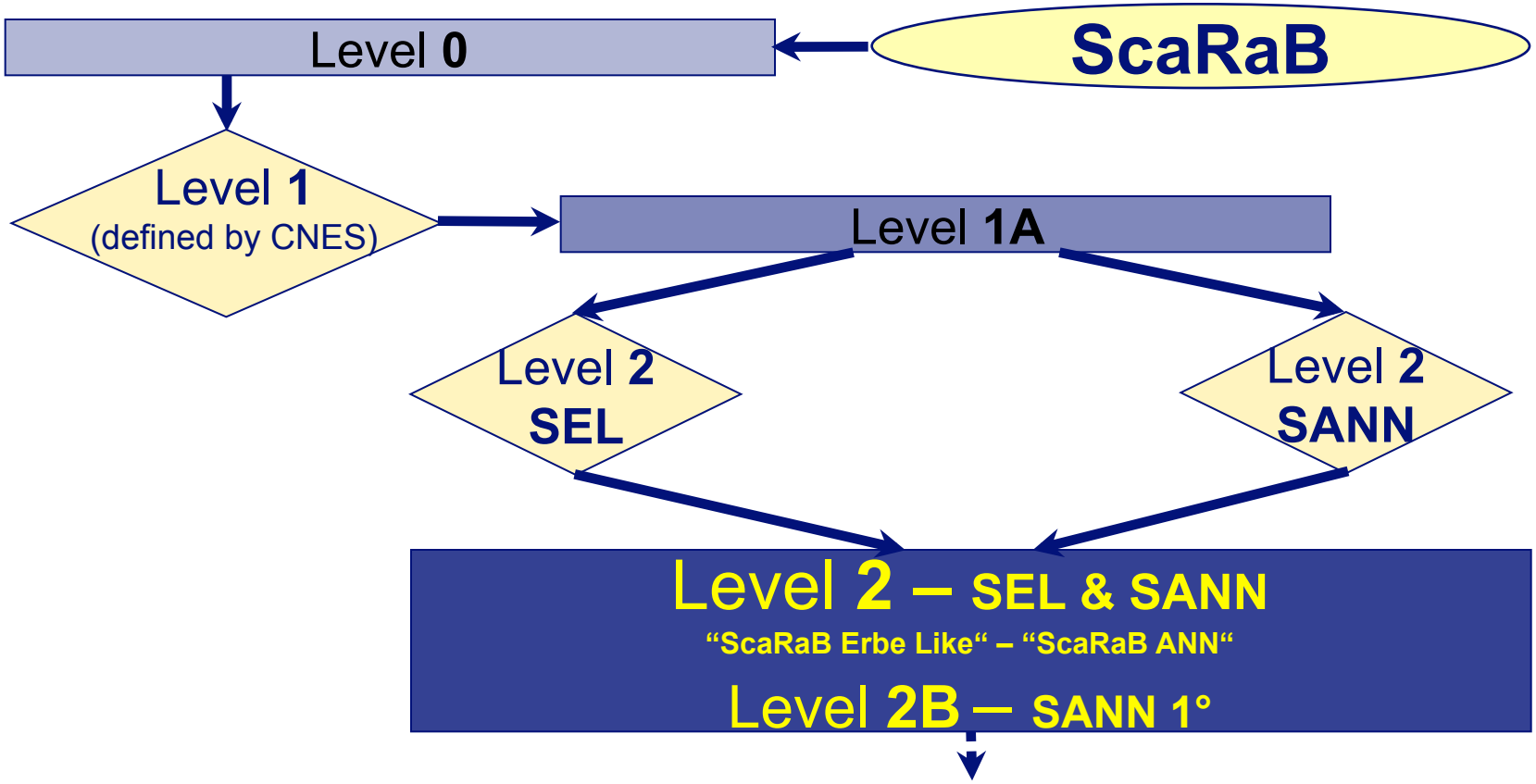
ScaRaB goal : To determine the longwave and shortwave outgoing fluxes observations at the TOA.

Channel	Description	Spectral Interval	Filter
1	VIS (visible)	0.55 – 0.65 µm	Interferential
2	SW (or solar)	0.2 – 4 µm	Silice filter
3	T (total)	0.2 – 100 µm	No filter
4	IR (Infrared)	10.5 – 12.5 µm	Interferential

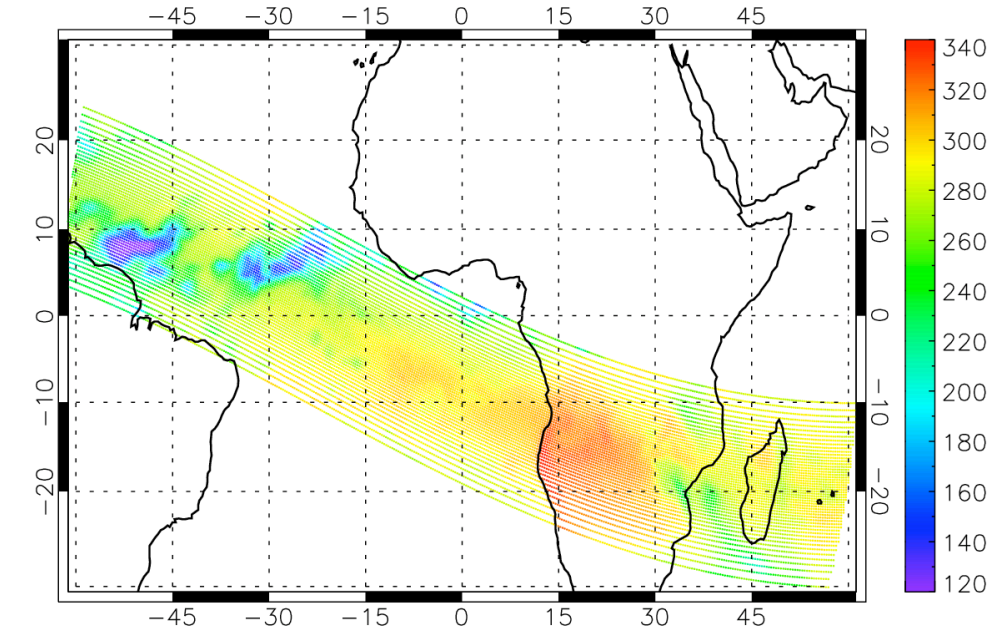
$$L_{LW\ (daytime)} = L_{TOTAL} - A' \times L_{SW}$$

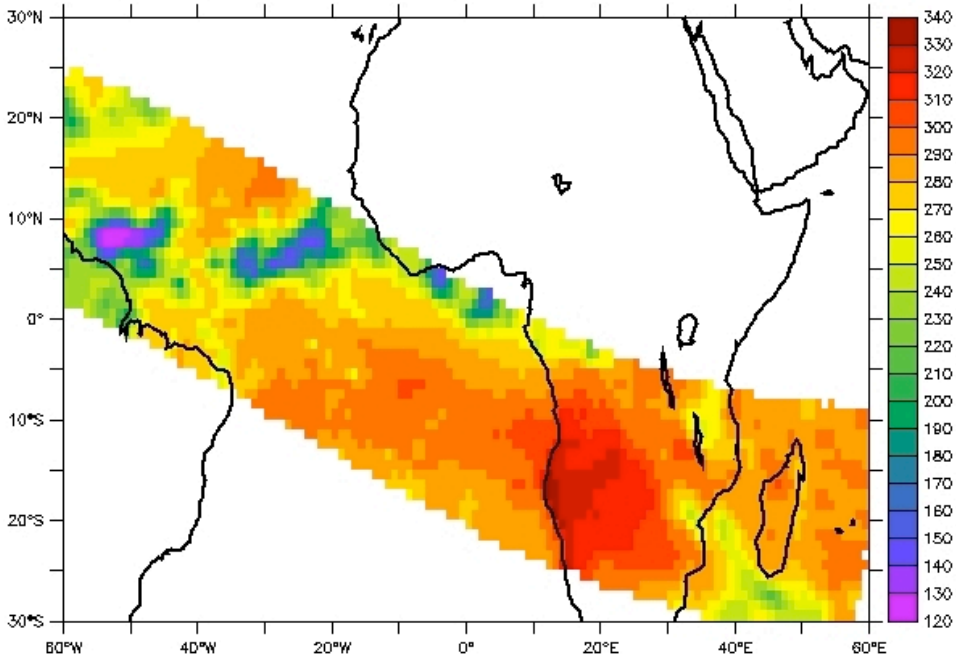
A' depends on the spectral response of T and SW channels

ScaRaB products



ScaRaB products – level 2B





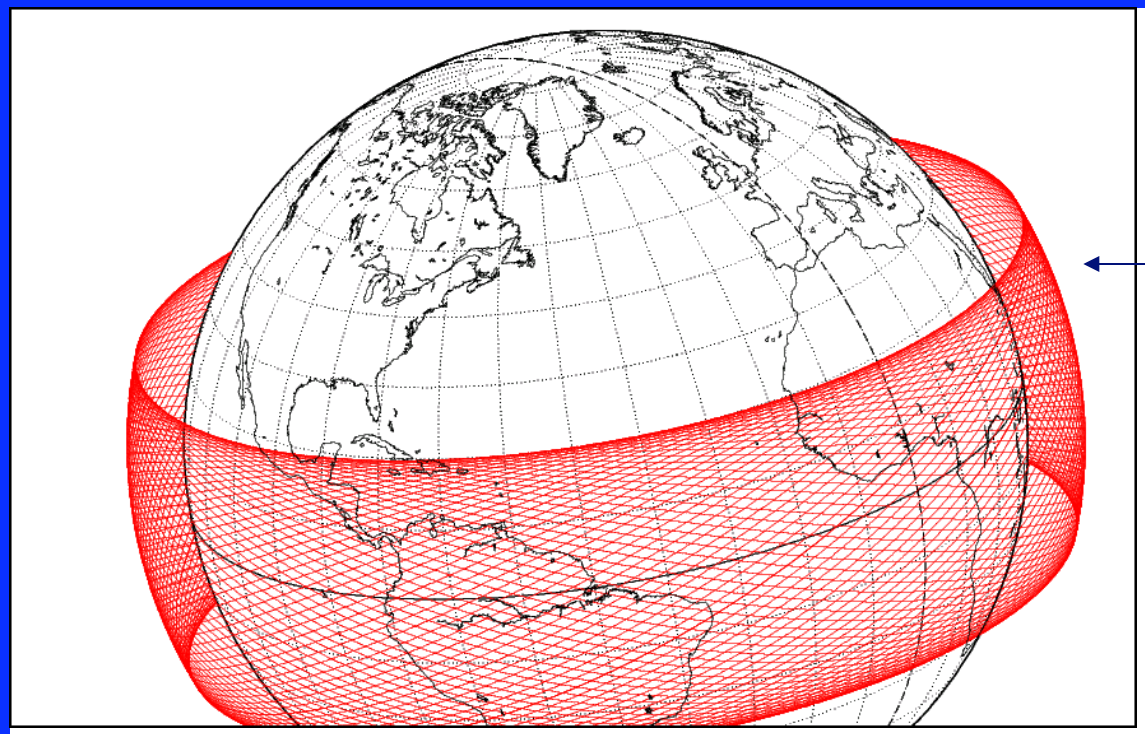
Exemple : LW Flux

Synthetic ScaRaB orbit from GERB data

22/06/2006 – 12h

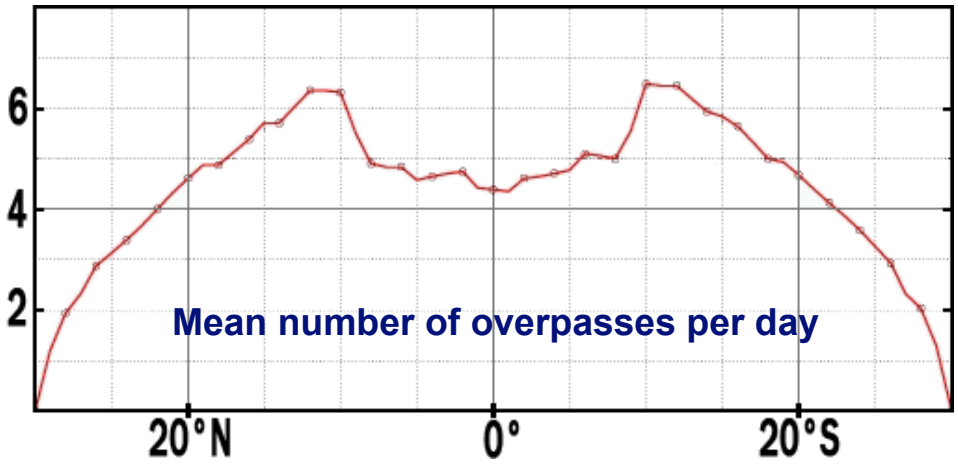
Level 2B :
Instantaneous fluxes over a 1°x1° geographical grid

ScaRaB - Orbit



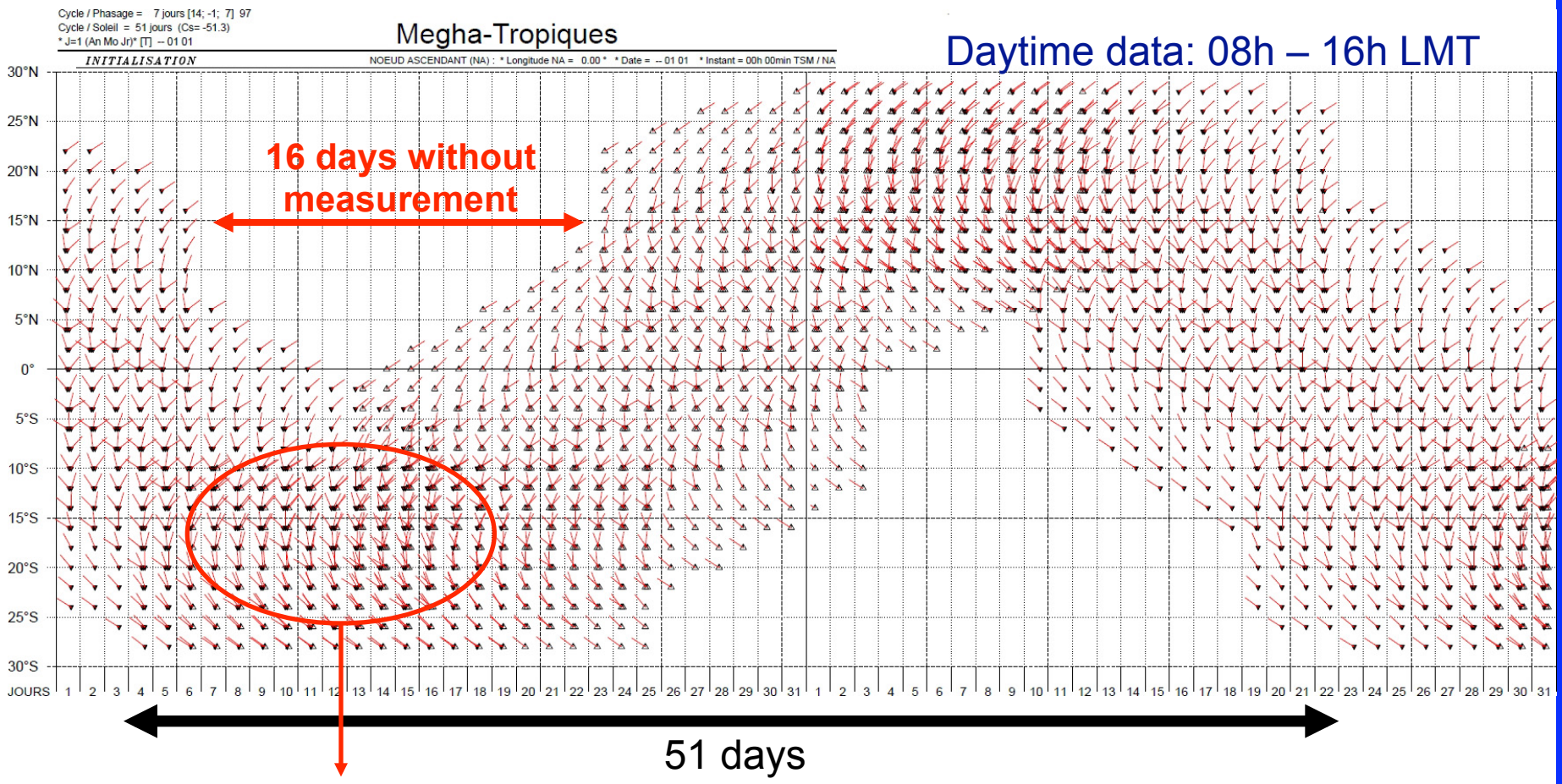
Inclination : 20°
Repeated cycle : 7 days
MT altitude : 865 km
ScaRaB FOV : 48.9°
Coverage : 30°N – 30°S

High temporal sampling



ScaRaB - Orbit

Megha-Tropiques precession cycle : 51 days



ScaRaB mean fluxes

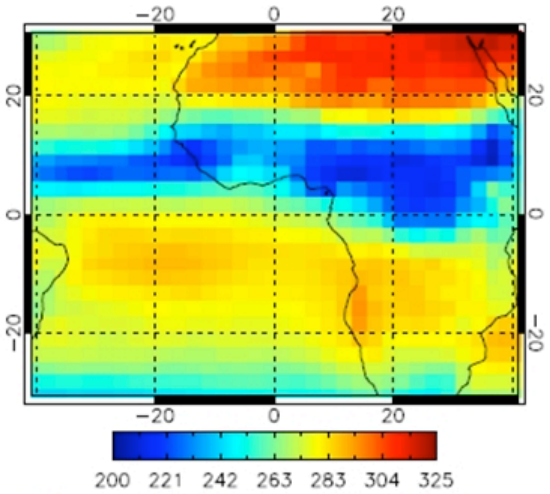


Figure : GERB means for LW fluxes between June 21 & August 10, 2006

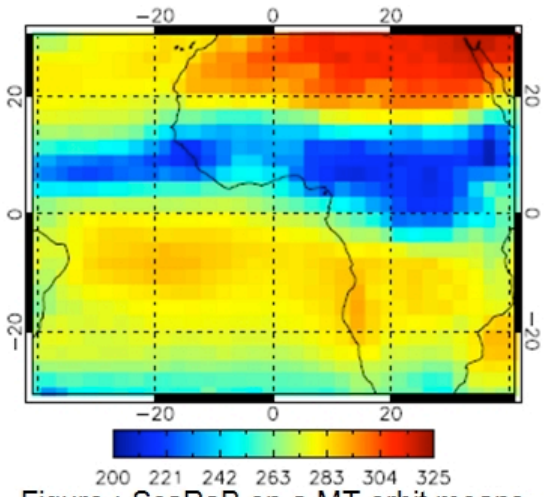


Figure : ScaRaB on a MT orbit means for LW fluxes between June 21 & August 10, 2006

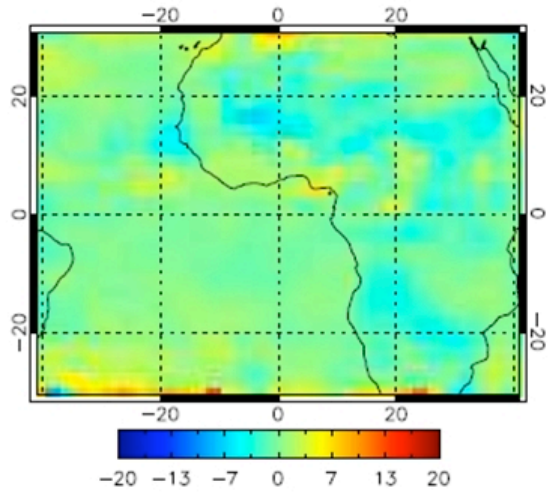


Figure : Difference between ScaRaB on a MT orbit and GERB between June 21 & August 10, 2006

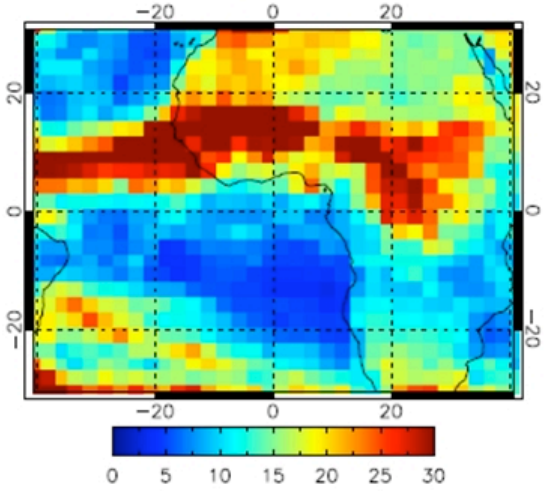


Figure : **RMS** of the difference between ScaRaB on a MT orbit means for LW fluxes between June 21 & August 10, 2006

LW Flux

Means over 51 days
(21/06/2006 – 10/08/2006)

GERB vs ScaRaB

ScaRaB mean fluxes

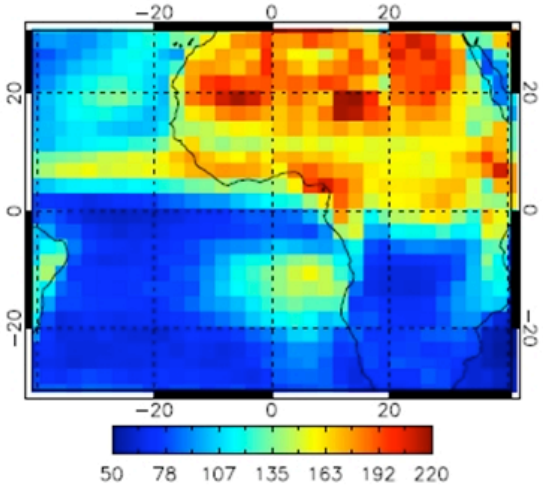


Figure : GERB means for SW fluxes between June 21 & August 10, 2006

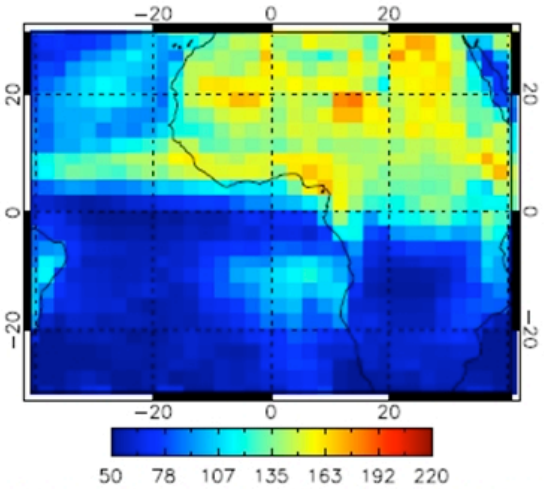


Figure : ScaRaB on a MT orbit means for SW fluxes between June 21 & August 10, 2006

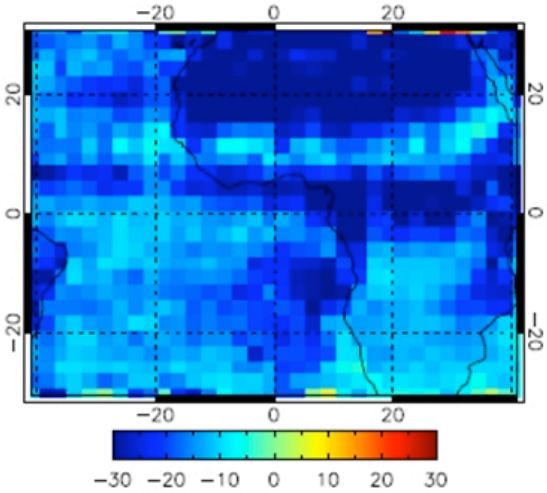


Figure : Difference between ScaRaB and GERB Sw fluxes means between June 21 & August 10, 2006

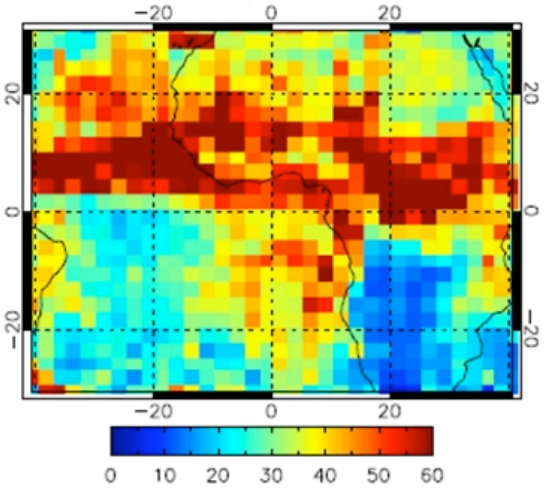


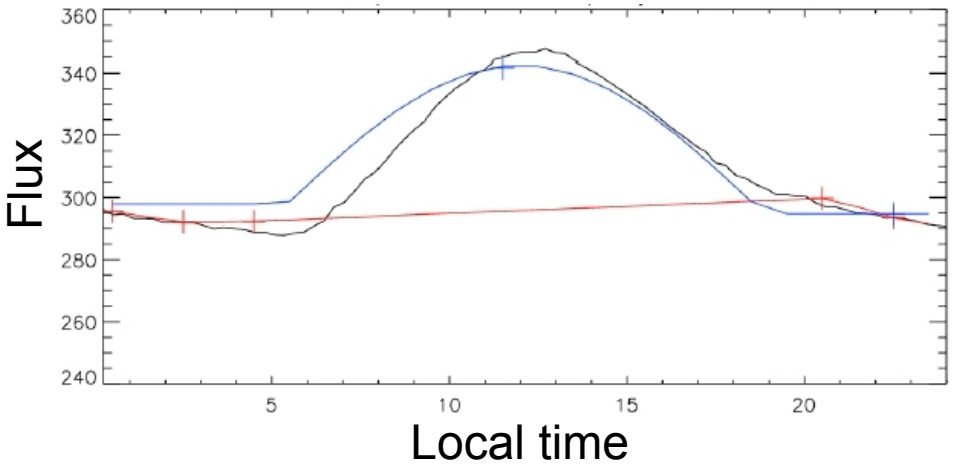
Figure : **RMS** of the difference between ScaRaB on a MT orbit means for SW fluxes between June 21 & August 10, 2006

SW Flux

Means over 51 days
(21/06/2006 – 10/08/2006)

GERB vs ScaRaB

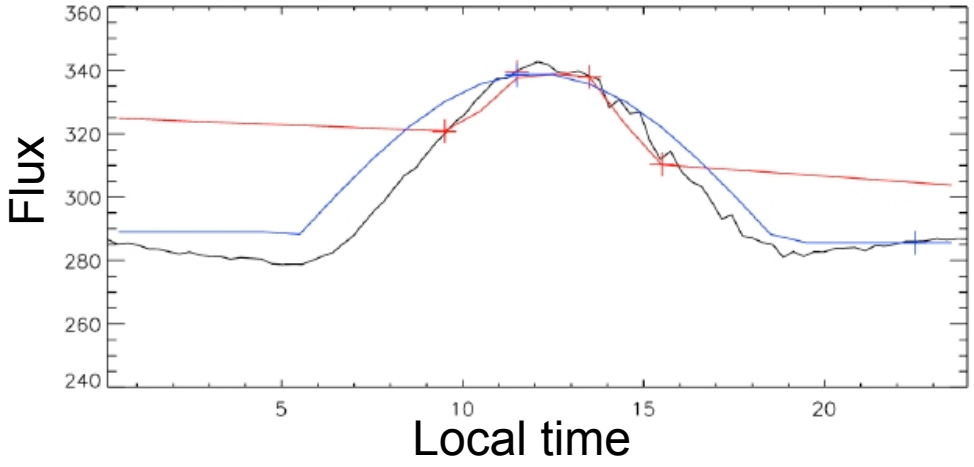
ScaRaB mean fluxes



Blue : Resurs
Red : MT
Black : GERB

11.25°N – 23.75°E

LW Flux
02/07/2006



Blue : Resurs
Red : MT
Black : GERB

11.25°N – 23.75°E

LW Flux
30/07/2006

Possible ScaRaB/others Comparisons

- Radiances comparisons of simultaneous co-located and co-angular observations

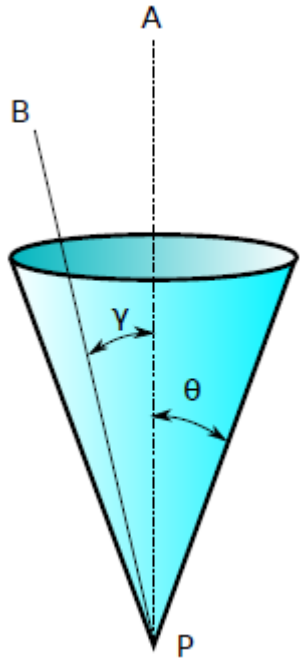
  SW radiances

  Co-angular (θ_{zenith} ±5° & $\theta_{azimuth}$ ±10° or conical aperture < 5°)

  Simultaneous (ΔT ± 7.5 mn)

  LW radiances

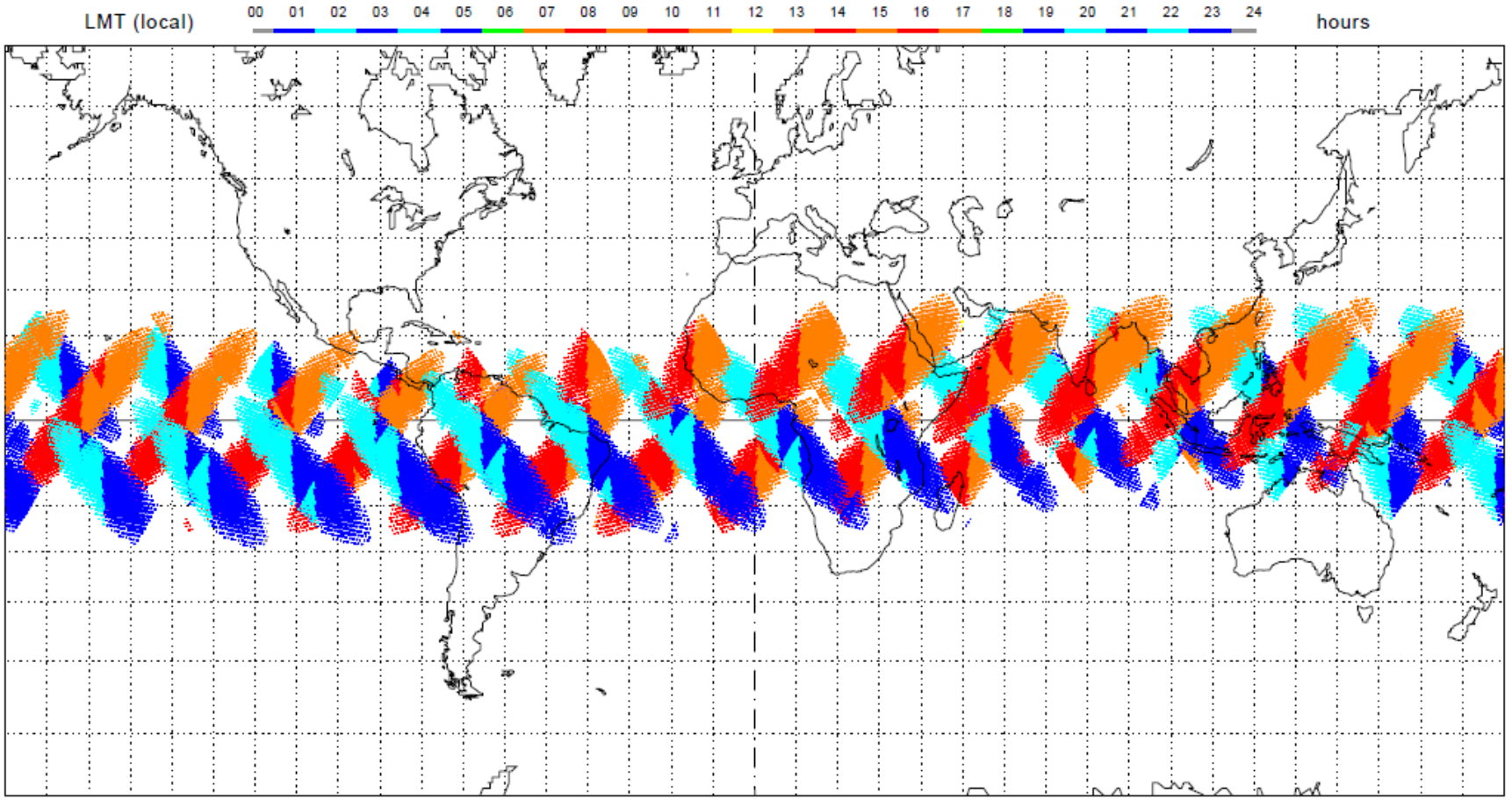
  Same as SW without the $\theta_{azimuth}$ constraint



- More comparisons !
  - Fluxes of simultaneous co-located observations
  - Monthly means fluxes of the common tropical area

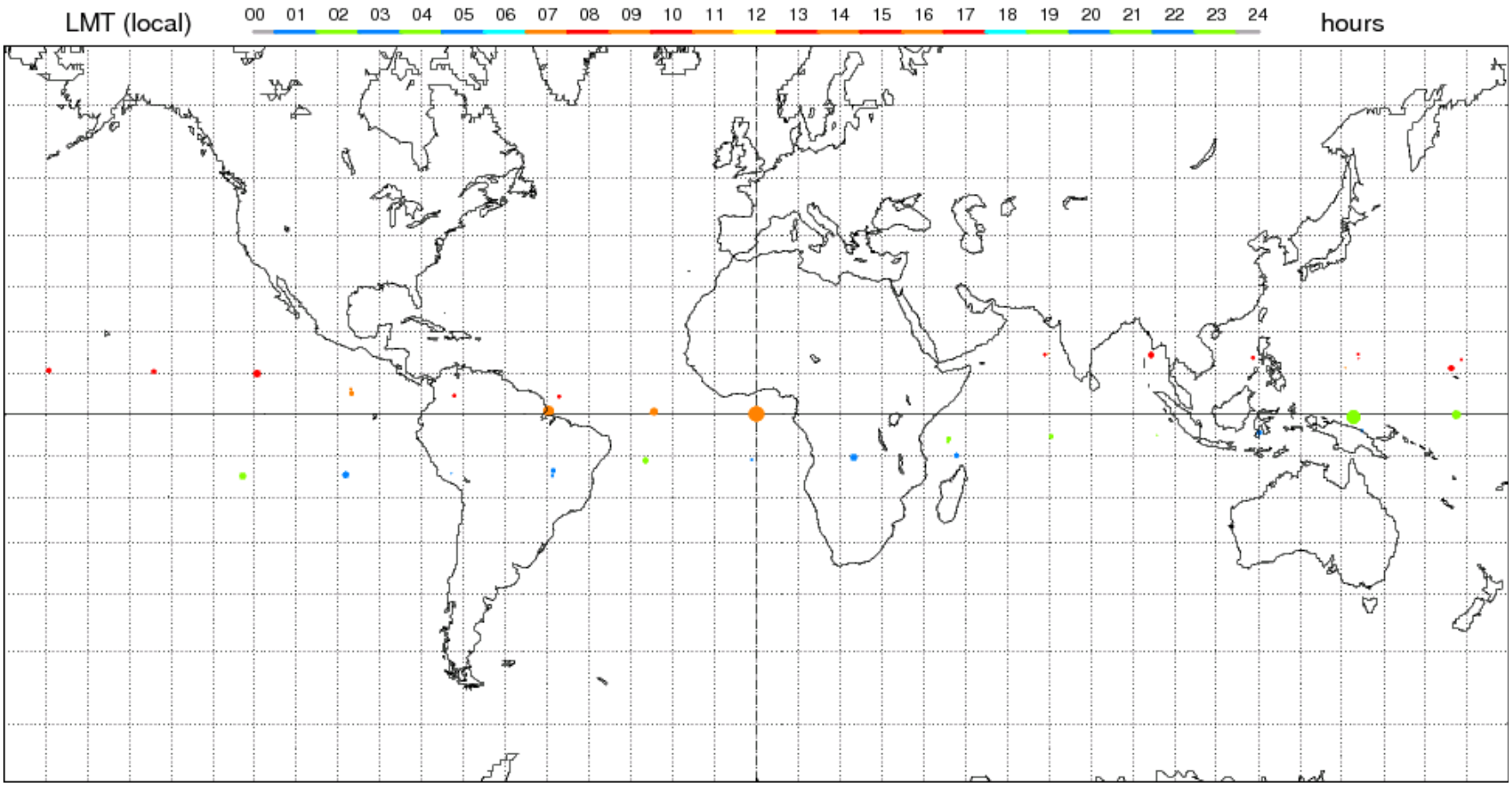
ScaRaB and CERES comparisons

CERES/Terra & ScaRaB/MT
Represented period : 16 days
Temporal colocation : 7’30”



ScaRaB and CERES comparisons

CERES/AQUA & ScaRaB/MT
Represented period : 16 days
Temporal colocation : 7’30”
Conical aperture **< 5°**



ScaRaB calibration/validation status

- **Ground Characterization**
  - spectral characterization
  - gain determination

  The detector characterization has been done by The Technical team at LMD.
  spatial response for each detector
  spectral response for each detector

  Gain determination has been done by CNES
  Integrating Sphere for the SW Channel
  Thermal Vacuum for the TW channel

- **In-Flight Calibration**
  - Using the on-board calibration module CALM & the filter wheel.
  - DCC method to validate SW radiances

- **Comparison with other ERB instruments**
  - CERES
  - GERB

ScaRaB calibration/validation status

- **In-Flight Calibration**
  - CALM : Black Body Simulator in front of each channel C2-C3-C4 & lamp in front of C1

  - The SW calibration now consists on direct intercomparisons of both SW and T channels over terrestrial scenes and on-board BBS by switching the silica filter.

  - These inter-comparisons also allow to detect long term drift of the relative spectral responses of the SW and total channels in the SW domain

- **DCC : Geophysical cross-calibration method**

  - Allow to simplify the original calibration system in the SW domain using Deep Convective Cloud

  - Analysis of very cold bright daytime cloud scenes over tropical convective regimes

  - for which the TW signal is dominated by SW reflection

  - and the residual LW component can be estimated independently from the IRW radiance (channel 4)

ScaRaB and CERES comparisons

Strict coangularity criteria is desirable to improve radiances matching for highly anisotropic scene ➔ inconvenient poorer statistics (especially for SW radiances)

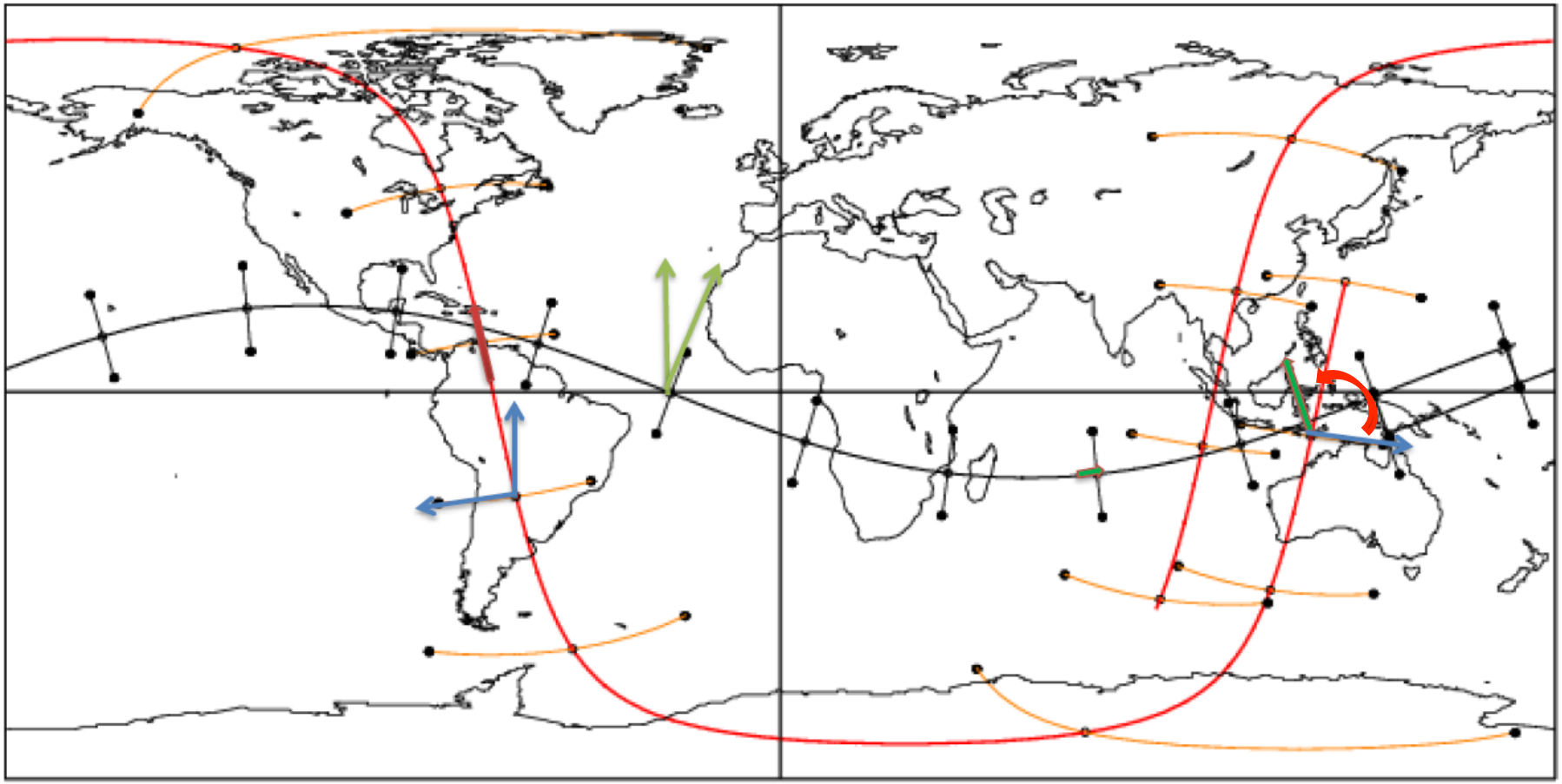
Coangular criteria ➔ Conical angle : 5° (see Clerbaux, 2009)

How to optimize the frequency of co-angular observations ?

CERES others scanning modes, an issue ?
(RAPS and FAPS)

How to choose the best angle for the FAPS mode

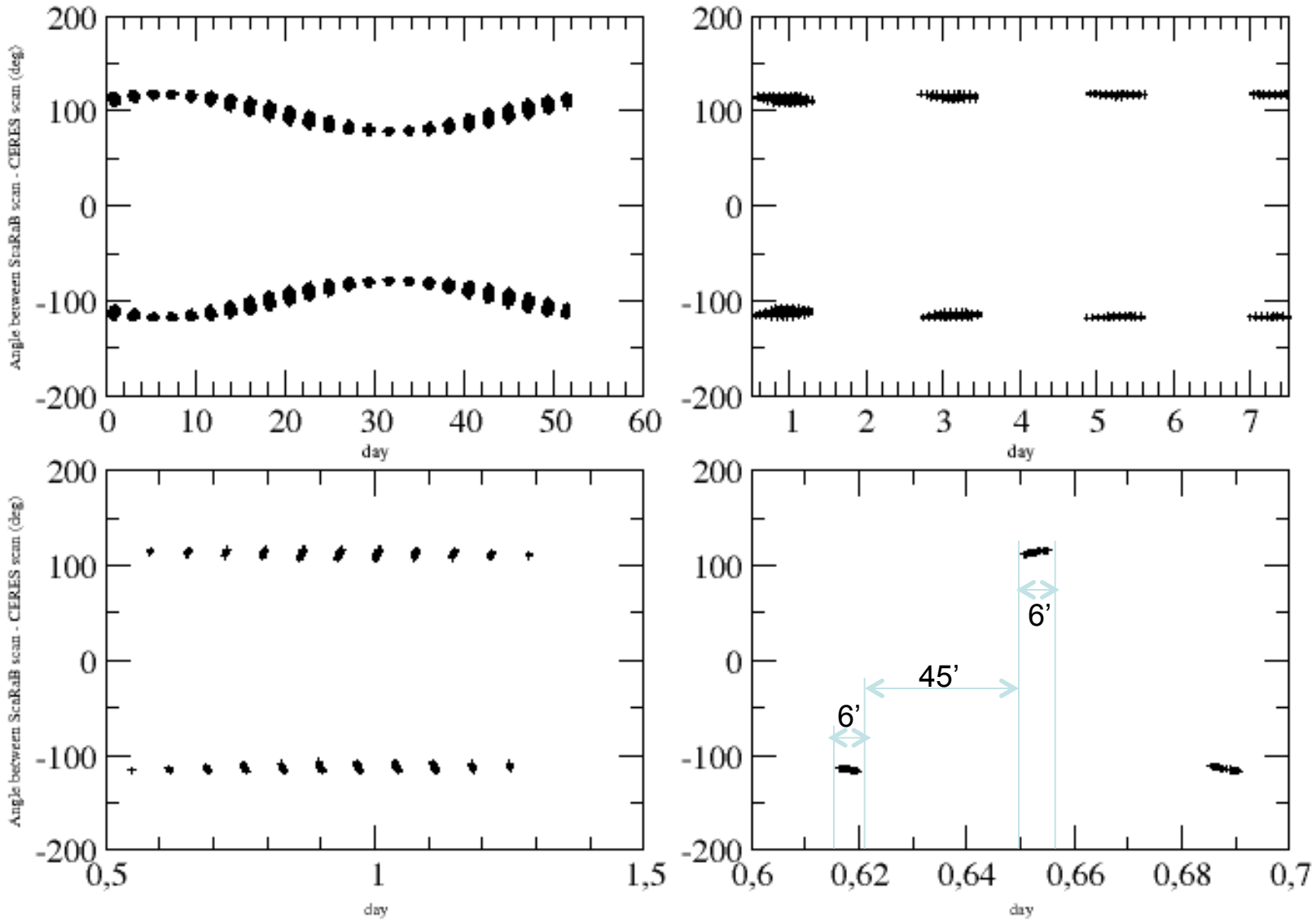
ScaRaB and CERES comparisons



Red : CERES (Terra)
Black : ScaRaB (MT)

The CERES scan plane is rotated in azimuth by this ANGLE so the CERES scan plan will coincide with that of ScaRaB

ScaRaB and CERES comparisons



Angles between ScaRaB scan & CERES scan (deg)

ScaRaB and CERES comparisons

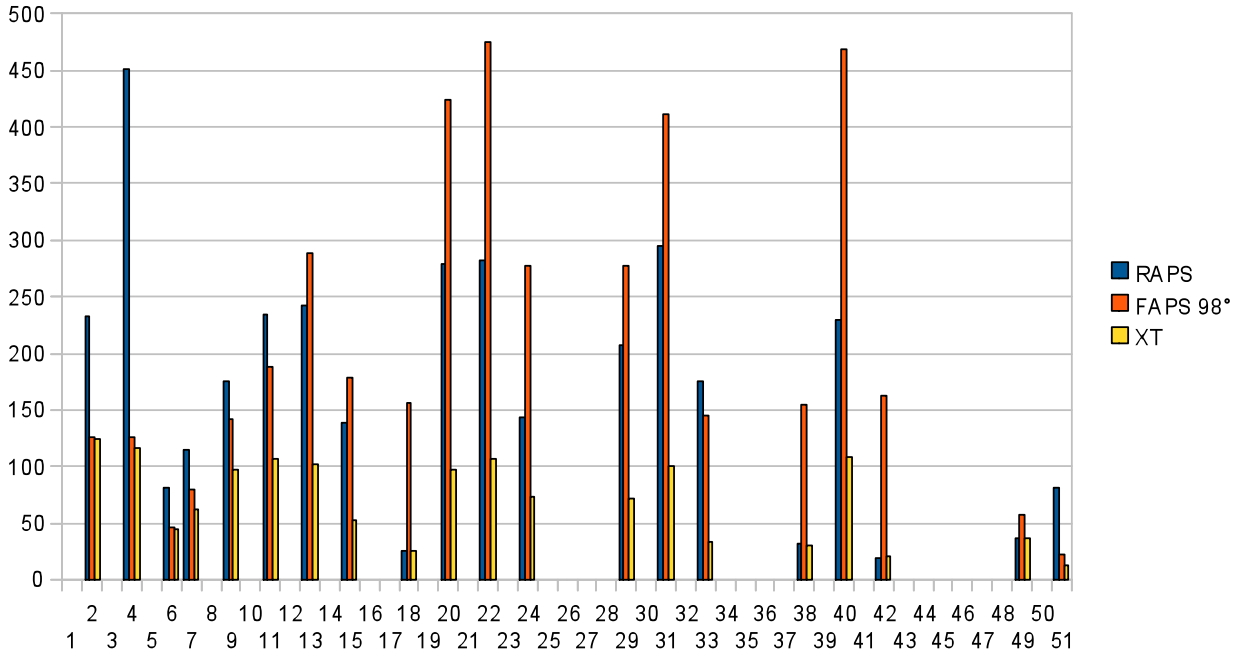
Statistics

± 7’30"

Co-located ScaRaB pixels number (51 days)	XT	RAPS	FAPS (98°)
Without any angular constraint	434,208	354,856	75,160
VZA ±5°	71,090	66,089	29,024
Conical aperture <5°	2,182	5,583	6,470

Co-located ScaRaB pixels number (7 days – days 18 to 24)	XT	RAPS	FAPS (98°)
Without any angular constraint	86,129	70,072	14,909
VZA ±5°	13,858	12,895	5,618
Conical aperture <5°	436	1,069	1,924

Cone < 5°



Conclusion

- Using the FAPS Scanning Mode increases the statistics by a factor 3 to 4 the co-located pixels between CERES and ScaRaB.

- Discussion with CERES Team of the opportunity to use FAPS mode.

Waiting for the data
Launch date : October 12th